

Report Documentation Page			<i>Form Approved OMB No. 0704-0188</i>	
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>				
1. REPORT DATE 30 SEP 1997	2. REPORT TYPE	3. DATES COVERED 00-00-1997 to 00-00-1997		
4. TITLE AND SUBTITLE Environmental Descriptors for Ocean Bubbles and Acoustic Surface Backscatter			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Johns Hopkins University, Applied Physics Laboratory, Johns Hopkins Rd, Laurel, MD, 20723			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 2
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	19a. NAME OF RESPONSIBLE PERSON	

ENVIRONMENTAL DESCRIPTORS FOR OCEAN BUBBLES AND ACOUSTIC SURFACE BACKSCATTER

Jeffrey L. Hanson

The Johns Hopkins University
Applied Physics Laboratory
Laurel, Maryland 20723

phone: (301) 953-6000 ext. 4292; fax: (301) 953-6908; email:jeffrey.hanson@jhuapl.edu
Award # N00014-97-1-0075

LONG-TERM GOALS

This work will contribute to the development of a global, physics-based model with readily observable air-sea inputs (i.e., via satellite) for the prediction of acoustic surface scatter in littoral and open-ocean environments.

SCIENTIFIC OBJECTIVES

The primary objectives of this study were to (1) describe the influence of bubble-related physical and biological factors on surface scattering strength (SSS), and (2) advance the development of surface wave descriptors for near-surface bubbles and acoustic backscatter.

APPROACH

A diverse set of observations made during the Critical Sea Test (CST) field program was employed to empirically relate deviations from Ogden-Nicholas-Erskine (ONE) SSS model predictions to various physical and biological factors related to the supply, mixing, and removal of upper ocean bubbles. Furthermore, new surface wave descriptors were calculated from observed directional wave spectra using a wave spectral partitioning approach to isolate wind seas, and an extension of Phillips' (1985) Equilibrium Theory was used to estimate the total rate of wave dissipation by breaking. The dependence of wave dissipation rate on ocean surface whitecap coverage was described empirically.

WORK COMPLETED

A preliminary assessment of the physical and biological factors most important for SSS site-to-site differences has been accomplished. In addition, a fully automated method for surface wave spectral partitioning, swell tracking, and storm source identification using MATLAB programming tools has been developed. These tools were used to successfully generate surface wave descriptors for air-sea processes models.

RESULTS

1. Biological productivity significantly increases SSS in the open ocean. This is likely due to increased dissolved gas levels and the presence of biochemical surfactants.
2. SSS is higher in warm water. This is probably a result of increased bubble supply and extended bubble lifetimes due to viscosity, surface tension, and gas solubility effects.
3. SSS increases in higher-energy environments. It is likely that elevated turbulence levels result in more entrained bubbles.
4. Wave spectral partitioning can be employed to extract wave descriptors for bubble related processes in the ocean.
5. Wave dissipation rate improves the standard power-law model for the prediction of ocean whitecaps.

IMPACT/APPLICATIONS

Physical and biological factors will amplify SSS variability in shallow water. These results demonstrate that a model could be developed for estimating SSS statistics in coastal areas using readily available (by satellite and operational models) inputs. The wave partitioning technique has several important applications, including the reduction and validation of global wave data sets, storm wave forecasting, and air-sea process modeling.

TRANSITIONS

The wave spectral partitioning approach is being used to examine acoustic surface interactions in the Forward Barrier program (J. M. Griffin /Code N875D).

REFERENCES

Hanson, J. L., 1996a. Wind Sea Growth and Swell Evolution in the Gulf of Alaska, Ph.D. Dissertation, The Johns Hopkins University.

Hanson, J. L., 1996b. Wave spectral partitioning applied to the analysis of complex wave conditions in the North Pacific Ocean, Eighth Conference on Air-Sea Interaction, The American Meteorological Society , pp. 61-65.

Hanson, J. L., 1997. Assimilation of surface wave spectral parameters for air-sea flux modeling, *Annales Geophysicae*, 15(Supplement 11), European Geophysical Society, pp. C406.

Hanson, J. L., 1997. Physical and biological descriptors for ocean bubbles and acoustic surface scatter, JHU/APL Technical Report STD-R-2694.

Hanson, J. and O. M. Phillips, Measurements of the spectral evolution of surface waves in the Gulf of Alaska using wave spectral partitioning, subm. *J Geophys. Res.*, 1997

Hanson, J. L. and O. M. Phillips, Wind sea growth and dissipation in the open ocean, subm. *J Phys. Oce.*, 1997.